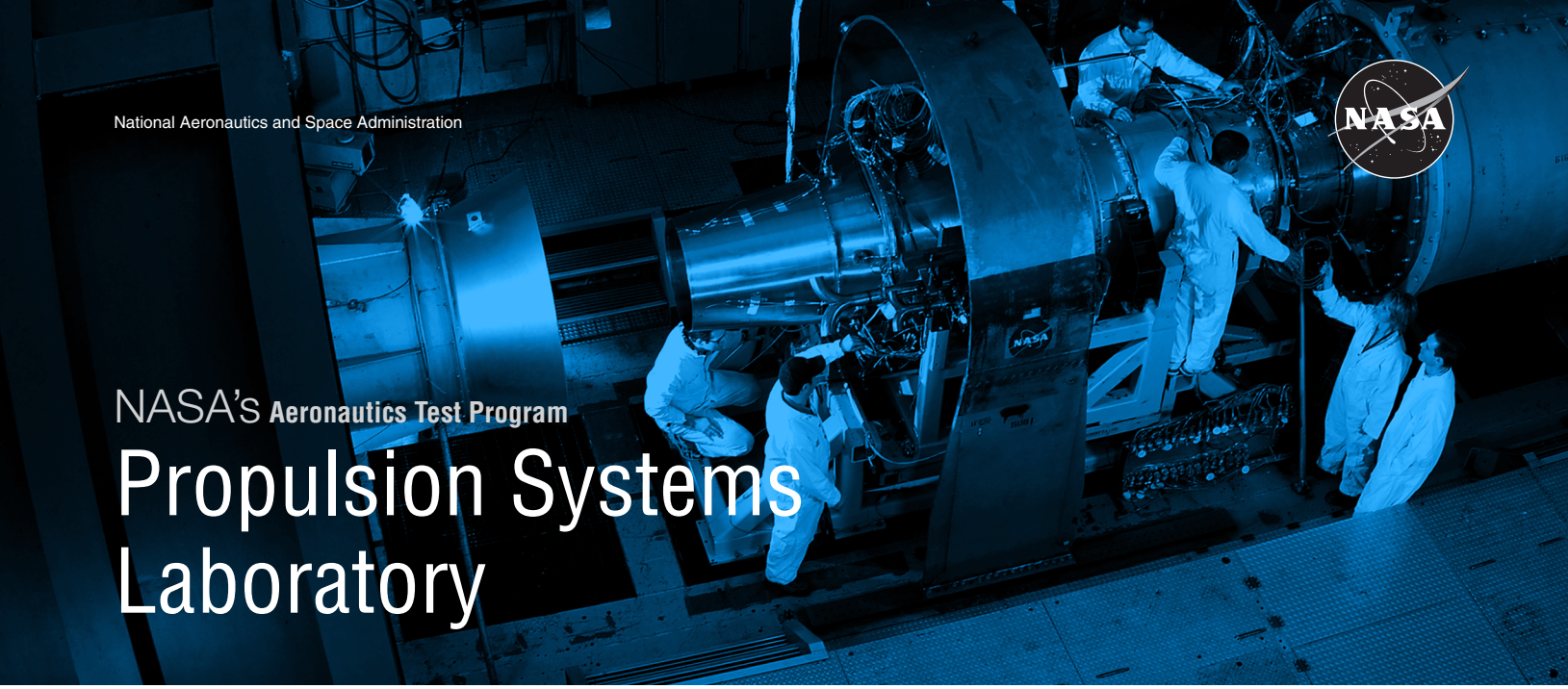
National Aeronautics and Space Administration

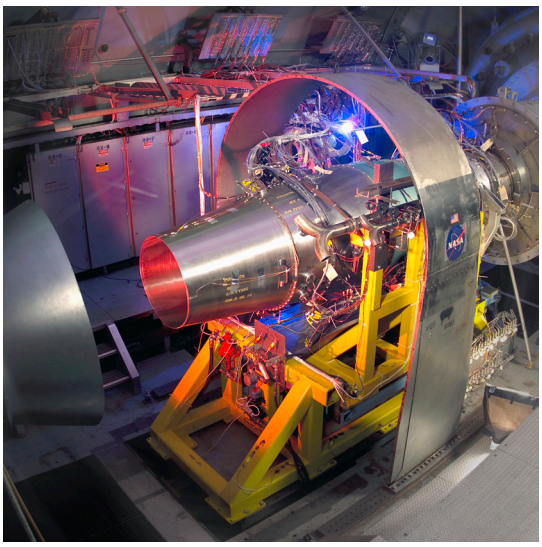


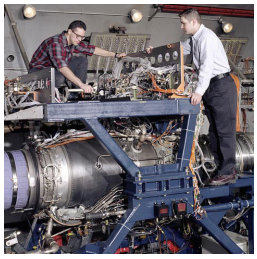
NASA's **Aeronautics Test Program**

Propulsion Systems Laboratory

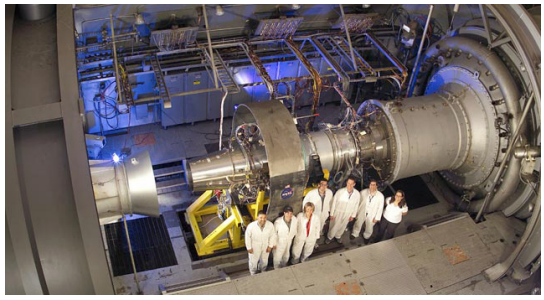
The Propulsion Systems Laboratory (PSL) is one of the premier U.S. facilities for experimental testing of advanced air-breathing propulsion systems. In this facility, altitude simulations at true flight conditions are created from sea-level static to hypersonic regimes for advanced aircraft, space propulsion, and general aviation programs. PSL is NASA's only continuous flow, ground-based facility of its kind.

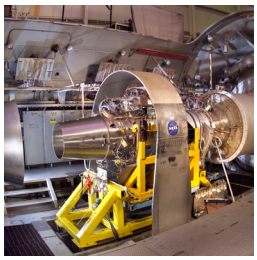
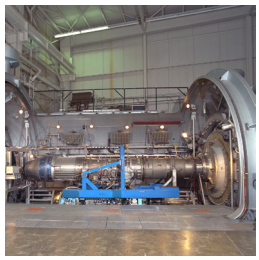
State-of-the-art test capabilities and techniques utilized in the PSL include multiaxis thrust measurement, vectored and reverse exhaust gas collection, infrared imaging at altitude, aeroelastic measurements, transient pressure and/or temperature distortion simulations.

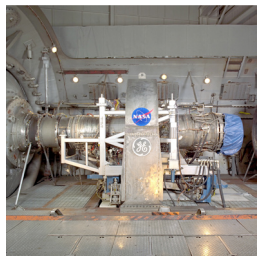




From left to right: Turbofan engine test setup, operators monitor a test from the control room, technical staff sets up an F–404 engine for testing, and the staff of the Propulsion Systems Laboratory.





Facility Benefits

- Creates temperature and pressure-inlet conditions that propulsion systems experience in high-speed, high-altitude flight
- Continuous flow facility with two test cells: PSL–3 and PSL–4
- PSL–3 simulates altitudes up to 70 000 ft and speeds up to Mach 3 for most engine applications; altitudes up to 90 000 ft are capable at lower airflows
- PSL–4 incorporates a high-temperature and high-pressure inlet plenum, addressing high-speed and high-altitude-propulsion-system test requirements for both aviation and space applications
- Axial and multiaxis thrust stand measurement up to 50 000 lbf
- Real-time, high-speed data acquisition and display
- Accommodates government and private industry test programs
- Infrastructure for secure test equipment
- Employs an experienced staff of technicians, engineers, researchers, and operators

Data Acquisition and Processing

Inputs	Analog, digital, and electronically scanned pressure (ESP) system
Display	Real-time, alphanumeric, and plots; 1-s update rate
Capacity/ channels	Real-time online analog signals, conversion to engineering units, calculations displayed in tabular or graphical format, over 2000 channels
Transient Multichannel high-speed digitized acquisition	186 channels with selectable filtering and 12-bit sigma-delta A/Ds, 100 000 sample-per-second data rate available on all channels simultaneously, Pacific filter amplifiers with Butterworth anti-aliasing filters (36 dB/octave), near-real-time calculations (including FFT), near-real-time graphical display, data exportable to 12 standard formats (customizable formats available on request)

Instrumentation

Pressure measurement Electronically scanned pressure (ESP) system	576 ports (each test cell)
Temperature measurement Thermocouples	480 (type CA) 24 (type T or R)
Gas analysis	Available upon request
Infrared imaging	Available upon request

Facility Applications

- NASA access to space propulsion
- National defense initiatives
- Commercial development
- Basic research
- Altitude engine icing (future)
- Engine programs including F110, PW308, F100, F404, FJ33/44, and PW545

Characteristics

Test cell dimensions	24 ft diam by 39 ft long
Simulated altitude	5000 to 90 000 ft
Simulated flight speed	
PSL–3	to Mach 3.0
PSL–4	to Mach 4.0
Inlet mass flow	
PSL–3 and PSL–4	to 480 lbm/s at 55 psia
PSL–4	to 380 lbm/s at 165 psia
Exhaust mass flow	to 750 lbm/s
Inlet total temperature	
PSL–3	–50 to 600 °F
PSL–4	–90 to 1000 °F
Core testing capability (alternate air source)	
PSL–4	up to 40 lbm/s at 1200 °F up to 100 lbm/s at 450 °F
Thrust measurement	
Axial	50 000 lbf
Vertical	15 000 lbf
Lateral	15 000 lbf
Fuel systems	Jet fuels (all types), hydrogen, and natural gas

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